JOURNAL OF ECONOMIC BIOLOGY.

ÜBER ZWEI NEUE ERIOPHYIDEN VON DEN FIDSCHIINSELN.

VON

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In Wien.

MIT TAF. X.

Eriophyes hibisci, nov. sp.

DER Körper ist zylindrisch, selten schwach spindelförmig, beim Weibchen durchschnittlich fünfmal so lang als breit, der Kopfbrustschild dreieckig, am Vorderrand abgerundet. Die Seitenränder desselben sind mässig ausgebogen und bedecken die Hüftglieder der Beine nur unvollkommen. Die Schildzeichnung ist sehr einfach und deutlich; sie besteht aus drei Längslinien im Mittelfeld, von welchen die mittlere in der Mediane des Schildes vom Hinterrand zum Vorderrand verläuft, während die beiden seitlichen stark nach vorn konvergieren und über dem Hinterrand winklig nach innen abbiegen. In den Seitenfeldern des Schildes bemerkt man gewöhnlich zwei kürzere Bogenlinien, die längs des Seitenrandes hinziehen; die äussere derselben ist länger als die innere und gewöhnlich an ihrem hinteren Ende winklig nach einwärts gebogen. Die Höcker der Rückenborsten sind gross, halbkugelig und ziemlich weit von einander entfernt am Hinterrand des Schildes, ohne jedoch ihn zu überragen. Die Rückenborsten sind wenig länger als der Schild, zart und nach hinten gerichtet.

Der Rüssel ist klein, schwach gekrümmt, schräg nach vorn gerichtet und an der Basis vom Vorderrand des Schildes bedeckt.

Die Beine sind mässig lang und schwach, die beiden Endglieder (Tarsalglieder) von fast gleicher Länge. Die Krallen sind schwach gebogen, die des zweiten Beinpaares etwas länger als die des ersten.

Das Sternum ist an seinem hinteren Ende nicht gegabelt und reicht bis zu den inneren Epimerenwinkeln. Die Brustborsten des ersten Paares sind etwas vor dem vorderen Sternalende, die des zweiten Paares weit vor den inneren Epimerenwinkeln zu beiden Seiten des Sternums ungefähr in der Mitte desselben inseriert.

Das Abdomen ist zylindrisch und beginnt erst im letzten Drittel seiner Länge sich zu verjüngen, um in einen kleinen, jedoch deutlichen Schwanzlappen zu endigen. Man zählt an der Rückenseite 60-62 Ringe; sie sind im allgemeinen schmal und gleichmässig fein punktiert, werden aber gegen das Hinterende allmählich, wenn auch unbedeutend, breiter und verlieren auf der Dorsalseite die Punktierung, so dass ungefähr 20 vor dem Schwanzlappen gelegene Ringe an ihrer Rückenseite glatt sind. Auf der Ventralseite des Abdomens sind die Ringe wenig schmäler und ihre Punktierung ist feiner und dichter. Die Seitenborsten sind etwas hinter dem Epigynium inseriert, sehr zart und fast so lang wie die Bauchborsten des dritten Paares. Die Bauchborsten des ersten Paares sind am längsten, etwa $1\frac{1}{2}$-mal so lang wie der Schild, am Ende sehr zart. Auffallend kurz sind die Borsten des zweiten Paares; sie haben etwa die Länge der Genitalborsten und sind auffallend weit von einander entfernt. Sie stehen von den Bauchborsten des zweiten Paares annähernd ebensoweit ab wie diese von den Seitenborsten. Die Bauchborsten des dritten Paares erreichen die Länge des Schildes und sind kräftig. Auf der Rückenseite des Schwanzlappens sind die geisselförmigen Schwanzborsten und die kurzen, stiftartigen Nebenborsten inseriert; die ersteren besitzen sehr biegsame, zarte Enden und erreichen kaum ein Drittel der Körperlänge.

Das Epigynium liegt unmittelbar hinter den äusseren Epimerenwinkeln am Anfang des Abdomens. Es ist 0.018 mm. breit, flach, beckenförmig; die Deckklappe ist längsgestreift. Die Genitalborsten sind noch seitenständig und kurz.

Das Epiandrium ist 0.016 mm. breit, flachbogenförmig.

Die mittlere Länge des Weibchens beträgt 0.18 mm., die mittlere Breite 0.036 mm.; die mittlere Länge des Männchens 0.15 mm., die mittlere Breite 0.035 mm.

Eriophyes hibisci erzeugt auf den Blättern von *Hibiscus rosa sinensis*, L. Ausstülpungen der Blattspreite nach oben, seltener nach unten. Im einfachsten Falle sind dieselben seichte Vertiefungen; indem sich jedoch dieselben vertiefen, entstehen beutelförmige, über die Blattfläche hervortretende Aussackungen, die nicht selten an ihrer Basis schwach eingeschnürt sind. Diese Gallen haben einen Querdurchmesser von 1.5-5 mm. und darüber und eine wechselnde Gestalt; gewöhnlich sind sie rundlich, knopfförmig, oben abgeflacht oder etwas vertieft. Aber auch längliche, bisweilen in der Längsachse stark gekrümmte Formen werden nicht selten angetroffen. Ihre Oberfläche ist unbehaart, fein gerunzelt; ihre Farbe lässt sich nach dem konservierten Material mit Sicherheit nicht bestimmen, jedenfalls dürfte sie von der Färbung des Blattes nicht auffallend verschieden sein. Die Gallen kommen sowohl auf der Blattfläche als auch am Rand des

Blattes entweder einzeln oder zu Gruppen vereinigt vor, welche dann zu grossen, unregelmässigen Massen mit höckeriger Oberfläche zusammenfliefsen. Die Gallenhöhle ist bei der geringeren Anzahl von Gallen ein einfacher, mit Haaren ausgekleideter Hohlraum, der mit einer weiten Öffnung nach aussen mündet; in der Mehrzahl der Fälle entspringen von der Innenwand zahlreiche zapfen- und leistenförmige Exkreszenzen, die vielfach mit einander verschmelzen und mit einzelligen, spitzen, farblosen Haaren bekleidet sind. Häufig füllen diese Wucherungen den ganzen Gallenraum aus und lassen nur enge, unregelmässige Hohlräume und Gänge zwischen sich frei, welche mit Haaren ausgekleidet sind und von Milben bewohnt werden. Bei stark infizierten Pflanzenindividuen treten solche Wucherungen auch auf dem Stengel, den Blattstielen, ja selbst auf den Blattnerven auf, wo sie als kugelige oder warzenförmige Gallen erscheinen, die teils einzeln, teils in Reihen oder zu Gruppen vereinigt auftreten; in letzterem Falle verschmelzen sie meist zu unförmlichen Massen und deformieren nicht selten ganze Pflanzenteile (Blattstiele, Nebenblätter). Sie sind sehr konsistent, an der Oberfläche behaart und von zahlreichen Lücken, unregelmässigen Hohlräumen und Gängen durchsetzt, in welchen die Milben leben.

Von den Cecidien der malvenartigen Pflanzen sind bisher die Triebspitzendeformation, Kräuselung und Rollung der Blattränder von *Malva alcea*, L. (Frauenfeld, 1870), und *Malva moschata*, L. (Geisenheyner, 1902), und die mit Erineum ausgekleideten Blattausstülpungen von *Gossypium barbadense*, L. (Ballou, 1903), untersucht worden. Canestrini untersuchte das Cecidium von *Malva alcea*, L. und bezeichnete als Urheber desselben eine neue Art, die er *Phytoptus malvae* nannte (Canestrini, Sopra due nuove specie di Phyt., in: Atti del R. Ist. Veneto, 1891, 2, 7); später zog Canestrini diese Art ein, indem er sie für identisch mit der von ihm auf *Geranium sanguineum* gefundenen Spezies *Phytoptus geranii*, Can., erklärte (Canestrini, Prospetto dell. Acarofauna ital. 5, 1892, p. 674). Ich hatte noch nicht Gelegenheit, die Richtigkeit dieser Angabe zu prüfen, bin aber mit Rücksicht auf die Natur der Wirtspflanzen der Meinung, dass hier ein Irrtum vorliegt. Weit wahrscheinlicher ist es, dass der auf *Malva alcea*, L., lebende *Eriophyes*, *E. gymnoproctus*, Nal. ist, den ich auf *Malva moschata*, L., fand (Nalepa, Neue Gallm., 21. Fortsetz., in: Anzeiger d. kais. Akad. Wien, 1902, p. 175). Das Cecidium von *Gossypium barbadense*, L., wurde bisher nur auf kultivierten Pflanzen beobachtet und im J. 1903 auf Montserrat (später auch auf St. Lucia und St. Kitt's) gefunden. Ballou war der erste, der dasselbe untersuchte und nachwies, dass es von einem *Phytoptus* sp. verursacht wird (Ballou, Insects attacking Cotton in the West Indies, in: W. Ind. Bull, 1903, v. 3, p. 282). Ballou teilt in seiner interessanten Arbeit mit, dass Herr

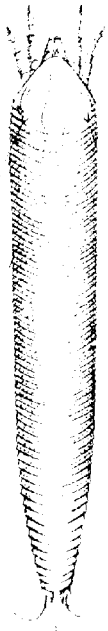
Banks diesen *Phytoptus* als eine neue Spezies bezeichnet und als "*Eriophyes gossypii*" beschreiben will (l.c. p. 282). Da wegen der nahen Verwandtschaft der Wirtspflanzen und der Ähnlichkeit der Cecidien die Möglichkeit nicht auszuschliessen war, dass die Gallen von *Gossypium* und *Hibiscus* von derselben Gallmilbenart erzeugt werden, war ich in Ermanglung einer Diagnose von "*Eriophyes gossypii*" gezwungen, mir durch eigene Anschauung Kenntnis von derselben zu verschaffen. Dies wurde mir durch die Freundlichkeit Sir Daniel Morris' ermöglicht, welcher mir gut konserviertes Gallenmaterial von *Gossypium* senden liess. Durch den unmittelbaren Vergleich beider Cecidozoën konnte ich unschwer feststellen, dass sie in wesentlichen Merkmalen voneinander abweichen. *E. hibisci* unterscheidet sich nämlich von der auf der Baumwolle lebenden Art hauptsächlich durch die abweichende Schildzeichnung, durch die auffallend kurzen Bauchborsten des zweiten Paares, durch den Besitz von Nebenborsten und endlich durch den Mangel der Punktierung auf der Dorsalseite des Schwanzabschnittes. Die Frage, ob *Eriophyes hibisci* auf *Gossypium* übergehen und Gallen erzeugen kann, lässt sich mit Sicherheit nicht beantworten; meines Wissens wurden bisher weder Infektionsversuche gemacht, noch sind Gallen von *E. hibisci* auf *Gossypium* bekannt.

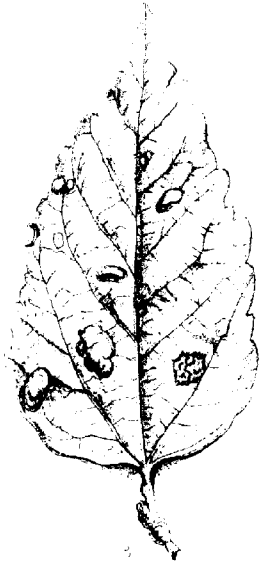
Die erste Kenntnis von den *Hibiscus*-Gallen erhielt ich durch Herrn W. E. Collinge, der so freundlich war, mir einige mit diesen Gallen besetzte Blätter zu senden. Die Untersuchung derselben konnte ich jedoch erst abschliessen, als mir das reichliche, wohl konservierte Material zur Verfügung stand, welches Herr C. H. Knowles in der Umgebung von Suva (Fiji) sammelte und mir bereitwilligst überliess. Nach der Mitteilung der Herrn Dr. K. Rechinger, Assistenten a. kais. Hofmuseum in Wien, welcher die Freundlichkeit hatte, die eingesendeten *Hibiscus-Blätter* zu untersuchen, stammen dieselben von *Hibiscus rosa sinensis*, L.

Als Einmieter in den *Hibiscus-Gallen* fand ich vereinzelte Exemplare eines *Eriophyiden* aus der Gattung *Oxypleurites*, der von den bekannten europäischen Arten auffallend durch die Stellung der Schildborsten am Vorderrand des Schildes abweicht. Da ich bis jetzt erst zwei weibliche Exemplare untersuchen konnte, ist es mir noch nicht möglich, eine vollständige Beschreibung dieser neuen Art zu geben. Die wichtigsten Merkmale derselben sind:

Oxypleurites bisetus, nov. sp.

Körper gedrungen, ventralwärts abgeflacht, hinter dem Schilde am breitesten. Schild gross, fast rechteckig, die Hüftglieder und den Rüssel vollständig bedeckend; Vorderrand mit zahnartigem Vorsprung über dem Rüssel. Schildborsten kurz, am Vorderrand des





ERIOPHYES HIBISCI.

Schildes inseriert und nach vorn gerichtet. Beine kurz, kräftig, die des ersten Paares stärker. Erstes Tarsalglied ungefähr doppelt so lang wie das zweite. Kralle geknöpft. Abdomen sich von den Hinterecken des Schildes in gerader Linie nach hinten verjüngend, etwa zweimal so lang wie der Schild. 1-10, Rückenhalbring breit, seitlich zahnartig vorspringend; 4-5 vor dem Schwanzlappen gelegene Ringe vollständig und schmal. Ventralseite abgeflacht, breit gefurcht, glatt. Die Bauchborsten des ersten und des zweiten Paares scheinen zu fehlen. Schwanzlappen sehr klein. Schwanzborsten sehr kurz. Nebenborsten fehlen. Epigynium gross, halbkugelig. Länge des Weibchens 0.15 mm., Breite 0.075 mm.

Vereinzelt in den Gallen von *Eriophyes hibisci* auf *Hibiscus rosa sinensis*, L.

ERKLÄRUNG DER TAFEL X.

Zur Arbeit von Professor Nalepa.

Fig. 1.—*Eriophyes hibisci*, n.sp. ♀. Dorsalseite. × 450.
Fig. 2.— „ „ „ „ Ventralseite.
Fig. 3.—Blatt von *Hibiscus rosa sinensis*, L., mit Gallen von *Eriophyes hibisci*, n.sp. Nat. Gr.

A NEW CABBAGE-EATING LARVA—
PSYLLIODES CHRYSOCEPHALA (LINN).

By

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With Plate XI and Text Figure.

EARLY in May of this year my friend and pupil, Brother Adolphus Ryan, handed me some young cabbage plants from Limerick which were drooping without any visible cause. Examination soon showed that there was a small circular hole, through which an insect had gained entrance (Fig. 1, A), situated in the stem just beneath the surface of the ground, and that the central tissue of the underground stem and root had been eaten away (Fig. 1, B). In two or three of the plants the destructive insect was still at work, and was easily recognized as the larva of some Chrysomelid beetle of the Halticine group. On providing one of the larvae with a little mould, I had the pleasure of seeing it quickly burrow into the earth, and three weeks later it had developed into the well-known and common beetle *Psylliodes chrysocephala* (Linn.). On sifting the soil, I found that the pupal stage had been passed in an oval earthen cell about three inches below the surface.

The beetle is well known to all collectors of the Coleoptera, and is commonly taken by sweeping various cruciferous plants, but so far as I am aware it has never been considered of any economic importance. The genus (*Psylliodes*), to which it belongs, is distinguished from *Phyllotreta*—the genus of the "Turnip Flies"—and most other *Halticinae* by the presence of ten antennal segments only (instead of eleven) and by the projection of the hind shin into a prominent process reaching some distance beyond the insertion of the foot. Two species of *Psylliodes* are well known for their depredations in the imaginal stage. These are the "Hop Flea-Beetle," *P. attenuata* (Koch), and the "Potato Flea-Beetle," *P. affinis* (Payk). *P. chrysocephala* is sufficiently described in systematic works on the Coleoptera.[1] It is

[1] See W. W. Fowler. The Coleoptera of the British Islands, vol. iv, p. 390, pl. 141, figs. 4-6.

about 4 mm. in length, usually of an uniform metallic green colour, the front of the head, the three basal segments of the feelers, the thighs of the fore and intermediate legs and the shins of all the legs being

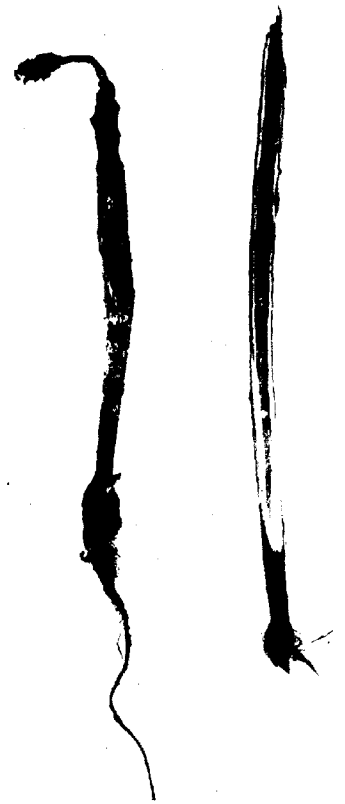

FIG. 1.—A. Cabbage plant injured by larva of *Psylliodes chrysocephala*, showing hole through which newly hatched larva enters the plant. B. Cabbage plant split open to show central cavity and decaying tissue due to the presence of the *Psylliodes* larva.

yellowish. There is, however, considerable variation in the colour of the species; several aberrations have received special names, and in

the specimen bred on the present occasion the head is almost entirely dark.

As I am not aware that the larva of any species of *Psylliodes* has ever been carefully described, and on account of the interest that attaches to any insect that asserts its economic importance, I have thought it desirable to take advantage of the opportunity of making the present slight contribution to our knowledge of the life-history of the *Chrysomelidae*.

Description of the Larva.

The fully-grown larva of *Psylliodes chrysocephala* is 8 mm. in length and narrowly sub-cylindrical in form (Pl. XI, fig. 1). Excepting for the head, the pronotal shield, and the ninth abdominal tergum, the cuticle is soft and white. The three pairs of short thoracic legs and the "anal proleg" are present, as is usual in larvae of this section of the *Chrysomelidae*.

Head.—The form of the head and the arrangement of its bristles may be gathered from figs. 2, 4, and 5. Except in the gular region the head-capsule is strong and well chitinized. It is light orange in colour, with dark chestnut-brown streaks arranged somewhat obliquely (Fig. 5). As usual, the neighbourhood of the sutures is pale. There is a darkly pigmented patch on each side behind the feeler, but no ocelli can be distinguished; apparently the sense of sight has been lost in correlation with the burrowing habit of the larva.

The feeler is excessively reduced (Fig. 3), consisting only of a short and wide basal segment and a sub-conical terminal segment. No trace of sensory structures can be seen on the latter, but the basal segment bears a short curved spine externally, and a prominent blunt spine with two smaller ones posteriorly.

The labrum (Fig. 10) is light yellow in colour, with longitudinal ridges and furrows on the distal part of its dorsal surface, on which four prominent bristles are situated. Its free edge is beset with four pairs of stout and a number of slender bristles, and a collection of tooth-like projections.

The mandible (Fig. 11) is strong, with three prominent apical teeth, and a large globular condyle for articulation with the head capsule.

The first maxilla (Fig. 12) is of the shape usual in larvae of this family, the palp being feebly chitinized and imperfectly segmented, while the galea and the lacinia are not distinct from one another. The extremity of the lacinia carries several blunt, stout spines, and along the ridge which appears to represent the inner edge of the galea there are four long flexible bristles. The outer edge of the galea is strongly chitinized.

The second pair of maxillae are intimately fused to form the labium (Fig. 13), which consists of a broadly truncated triangular basal part, strongly chitinized externally, but white and membranous centrally, and carrying the feebly chitinized palps, each with a broad basal and a slender terminal segment.

Thorax.—The pronotum is firm and coriaceous in texture, pale in colour, and of somewhat wrinkled surface, with four series of dark impressed punctures arranged lengthwise (Fig. 1). On the mesothorax and the metathorax there is a conspicuous darkish granular lateral patch carrying three strong bristles, and a smaller dorso-lateral patch with one bristle. The thoracic spiracles are situated ventro laterally between the bases of the front and intermediate legs (Fig. 1).

The legs (Figs. 1, 8) are short and stout, showing only three distinct segments. A small sub-triangular, strongly chitinized thoracic sclerite overhangs the base of each leg, and the proximal segment of the leg is strengthened by a broad, arched, chitinized region, beset with a series of strong bristles. There is a similar but narrow sclerite at the base of the second segment. The terminal segment carries a strong claw, from the base of which projects a long setiform process, while internally to the claw is situated a large, wrinkled bladder-like tunica (Fig. 9). It is impossible not to be struck with the similarity of this arrangement to what is found in the foot of a Collembolan of the genus *Sminthurus*.

Abdomen.—The first eight abdominal segments are all closely alike (Figs. 1, 6, 7). The circular spiracle is situated laterally; ventral to it is a dark, granular patch with two bristles on either side, a smaller, similar patch with one bristle, and dorso-anteriorally to it another small patch with one bristle. Three transverse rows of simple bristles (2, 2, 4) are to be seen on the dorsal region of each of these segments.

The ninth abdominal segment (Figs. 1, 6) has the tergum well chitinized, with straight lateral and rounded hinder margins, the central region being somewhat depressed and marked by longitudinal series of dark, impressed punctures. It is raised into two prominent hooked spines which point upwards and inwards.

Bionomic Notes.

The appearance of the injured plants leave no doubt that the female beetle must lay her eggs on the underground part of the stem, that the young larva immediately burrows through into the interior, and then feeds in the central tissue of stem and tap-root until fully grown. The pupal stage lasts about three weeks, and is passed in an earthen cell just beneath the surface. As most of the *Halticinae* are (or are believed to be) leaf-feeders, both in the larval and imaginal

stages, this habit is of interest apart from its economic importance. A large proportion of the field under observation had been damaged by the larvae; hence this method of feeding had been adopted by a large number of individual insects. Brother Ryan has informed me since the summer that while the younger plants attacked by the larvae succumbed, those that were strong and well-grown recovered.

It is impossible that this insect should have often injured cabbages or other cruciferous crop plants in this way before. If so, the attention of the naturalist must have been called to the occurrence. Probably the usual food of the larvae has been the stems and roots of cruciferous wild plants. The appearance of this and other insects with comparative suddenness in the part of economic pests suggests that we can see in such cases a new method of feeding adopted by many individuals of a species at the same time. And, most curiously, the change of habit may sometimes be observed in different localities. It will be interesting to learn if the larvae of this beetle have been detected elsewhere as destructive to cultivated plants.

EXPLANATION OF PLATE XI.

Illustrating Professor Carpenter's paper on *Psylliodes chrysocephala*.

Fig. 1.—	Larva of	*Psylliodes chrysocephala*.		Lateral view. × 10.
Fig. 2.	,,	,,	,,	Head, ventral view. × 40.
Fig. 3.	,,	,,	,,	Right feeler, ventral view. × 300.
Fig. 4.	,,	,,	,,	Head, dorsal view. × 40.
Fig. 5.	,,	,,	,,	Head, lateral view. × 40.
Fig. 6.	,,	,,	,,	Hinder abdominal segments, dorsal view. × 20.
Fig. 7.	,,	,,	,,	Fourth abdominal segment, lateral view. × 20.
Fig. 8.	,,	,,	,,	Left hind leg. × 60.
Fig. 9.	,,	,,	,,	Hind foot, showing claw and tunica. × 300.
Fig. 10.	,,	,,	,,	Labrum, ventral view. × 200.
Fig. 11.	,,	,,	,,	Left mandible. × 200.
Fig. 12.	,,	,,	,,	Right maxilla. × 200.
Fig. 13.	,,	,,	,,	Labium. × 200.

LARVA OF PSYLLIODES CHRYSOCEPHALA (Linn.)

ON THE LIFE-HISTORY OF STOMOXYS CALCITRANS, LINN.

By

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With Plate XII.

It is, I believe, over 60 years since Bouché discovered the larvae of *Stomoxys calcitrans* in warm stable-manure. Since that time no additional information on the habits of this insect has apparently been given; and the characteristics of the earlier stages and also the metamorphoses have remained practically unknown. It was resolved therefore to:—

1. Trace out the life-history and metamorphoses by rearing the insect from the egg; and
2. To find the natural habitat for the eggs, larvae and pupae.

The first was accomplished with comparatively little trouble; but the finding of the natural habitat for the earlier stages of this insect proved no light task, and involved a considerable amount of time and diligent searching. In the end, however, I succeeded in solving these problems; and it is hoped that these notes will not only prove of interest, but also of some practical value to those students who are engaged in the study of insects in connection with the transmission of disease by blood-sucking flies.

During the month of August an unremitting search was made for the larvae and pupae of this insect in the faeces of nearly all the domesticated animals, both in the farm-yards and the fields, but without success; manure heaps both old and recent were also searched, but none were discoverable. A number of females were then captured and placed in a large cage well supplied with light and air, and fresh faeces of the horse, sheep, and rabbit. A small percentage of the insects laid their eggs under these conditions; but the eggs were invariably removed to receptacles which were more convenient for the study of the metamorphosis. It was found that two important conditions were necessary for the development of the larvae, viz., an almost

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complete absence of light and *an abundance of moisture*. Such conditions as these could only obtain in a state of nature in large faeces in shady or damp situations, or in heaps of manure.

Towards the end of September the earlier stages of this insect were found under natural conditions, and the facts relating to them are given under the heading of additional field notes.

HABITAT.—Farm-yards and stables are evidently the favourite haunts of this fly; it occurs also in the fields, parks, and open woods, especially where cattle are grazing, but is much less numerous in such places. It is evidently also by no means uncommon in some of our large towns, and numbers were seen at rest on the shop-fronts in the main streets of both Liverpool and Chester. It is fond of resting on surfaces fully exposed to the sun, such as doors, gates, and rails, and to a less extent also on stone and brick walls. Painted surfaces are also attractive to it, and the greatest number seen congregated together were disporting themselves on the sunny side of a red-painted iron tank at the old Chatteau de Goumont, Waterloo, Belgium. They are very active; but their flight is quite inaudible at a short distance, the noise produced being very feeble. When disturbed they frequently return to the same spot, but more especially so in favourite resting-places. At night they retire to some sheltered spot, and numbers may be found at rest on the beams and rafters in open sheds in farm-yards, where they remain, almost inert, till the morning sun tempts them out again. They will also occasionally enter stables in the day time, and they were seen to enter such places through a narrow opening or a crack in the door.

They frequently clean their wings when in captivity, and this is accomplished with great precision, the hind legs being used for this purpose. The under surface of the wings are first combed, then the upper, the legs are then rubbed together, and the process is again repeated in exactly the same order.

POSITION WHEN AT REST.—The front part of the body is often slightly raised, but not invariably so; and the wings, which invariably touch at their bases, are widely divergent and carried in a horizontal position, lying practically in the same plane as the abdomen.

RATIO OF SEXES.—During the heat of the day the males preponderated;[1] but towards evening the sexes occurred in about equal numbers; the captured females, were, however, nearly all freshly emerged ones, and a large proportion of the eggs which they laid in captivity proved infertile.

[1] The ratio was about 3 males to 1 female.

FOOD OF THE ADULT.—During a period of 14 days a careful watch was kept on both cattle and horses in various farm-yards where the flies were common, but no flies were seen either to alight upon the animals or to suck blood from them; at the same time several examples of both males and females were captured which were fully engorged with blood. Moreover, a freshly emerged male readily sucked blood from the writer's own hand. There is, however, no lack of authentic evidence as to the blood-sucking habits of this fly which need not be repeated in this communication.

Two specimens were seen to settle on fresh cow dung, and apparently feed upon the moisture on it, passing the extended proboscis rapidly over the surface; such habits were apparently exceptional or rarely seen in a state of nature; but in captivity they readily fed on the fresh faeces of the horse and sheep, more especially so on the latter. A female was also seen to drive its proboscis into the thorax of a dead companion and apparently suck up the juices of its body. Three specimens fed upon some sugar and water, and some also sucked up the moisture from a decayed and fetid potato.

MOVEMENTS OF THE PROBOSCIS.—The base of the proboscis is frequently depressed so that the palpi become fully exposed, but the tip of the labium remains practically in the same position, or is very slightly elevated. The elbowed joint in front of the palpi is very flexible, and can be instantly inflated so that the entire proboscis can be completely straightened, and either extended horizontally or depressed vertically. The labella can also be:—

1. Straightened, taking the same plane as the labium proper. This is the normal resting position.
2. Curved upwards and outwards, with a quick alternate movement to either the right or left, or repeatedly and rapidly curved to one side only. As the labella curve upwards the *anterior* portion of the labium also gives a distinct lateral twist, so that the dorsal groove is presented laterally.
3. The teeth of the labella can be curved outwards and ventralwards, giving them a bilobed appearance; the teeth also apparently move rapidly backwards and forwards, and a clear fluid was seen to pass down the tube when the insect was slightly pinched between the fingers.

In sucking blood from the writer's hand the insect sat high upon its legs, but the anterior pair were much elbowed, and all the joints of the tarsi generally rested upon the skin of the host. The whole of the proboscis was straightened and held vertically, and the anterior third was driven into the flesh.[1] During the process, which lasted alto-

[1] In thick skinned animals the proboscis would in all probability be driven in still further.

gether for a period of 15 minutes, the proboscis was constantly, but somewhat slowly, moved up and down, and also with an occasional semi-rotary movement, reminding one somewhat of the action of a quarryman's hand drill. This action was continued until the fly had pumped its body full of blood. The initial pain was trifling compared with that of a mosquito; but there were two subsequent pricks which were quite as irritating as the first. A small drop of blood was left over the puncture, and when this was washed away a small roseola was revealed; but there was no subsequent irritation or soreness of any kind. A clear fluid was passed from the anus four times during the process, and on several occasions subsequently, and judging from the size of the abdomen the food was rapidly assimilated. This fly died 12 hours after feeding.

DURATION OF LIFE.—In captivity they lived for several days; but they were supplied with abundance of fresh air and some moist faeces. The females died either immediately or shortly after laying their eggs.

EGG-LAYING.—When the female is about to lay its eggs the ovipositor becomes fully extended, and nearly equals the length of the abdomen proper. The eggs are passed rapidly down the ovipositor at intervals of a few seconds,[1] and were usually laid in an irregular heap. In some instances the female was seen to separate the eggs by carefully passing her proboscis between them, and then drag them away or scatter them with her legs. In cases where the eggs were laid during *extremis* the female generally died on the spot, and made no attempt to scatter them. Counts were made of seven batches, the maximum being 71, the minimum 48; the actual counts were 48, 48, 54, 57, 59, 62, 71. The incubation period, at an average temperature of 72° F. in the day and 65° F. at night, was two to three days.

TIME OF APPEARANCE. They are especially abundant during August and September; but gradually diminish in numbers during the early part of October; and few examples are seen after a spell of cold wet weather.

THE EGG.—Coriaceous; white at first, but changing to creamy white. Those which were laid on faeces, fully exposed to the sun, had the exposed portions tinged with pinkish-brown, but this colour eventually disappeared. Form very elongate, shaped somewhat like a banana, being curved on one side and almost straight on the other; the straight side with a broad deep groove which widens at the anterior end giving it a spatuloid form. Surface with faint polygonal

[1] 5·30 seconds.

reticulations. The larva effects its escape by splitting the broad end of the groove, leaving it slightly raised (see Fig. 4), and apparently intact on the opposite side.

Length, 1 mm.

THE LARVA.—Colour, creamy-white to pale ochreous, translucent, shining and almost glass-like; sub-cutaneous mouth parts black; the convoluted alimentary tract when filled with food gives the posterior half a blackish or greenish-black colour; tracheal tubes forming two submedian white lines and delicate lateral branches. Posterior stigmata black; thoracic stigmata ochreous. Form long, tapering to a point in front, widely rounded posteriorly. Segmentation not very pronounced. Epidermis without hairs. Head with two large divergent mammiform processes, at the extremity of which are the minute retractrile antennae, apparently of four sub-equal segments. The mouth armature consists of five distinct parts: a strongly falcate hook in front, which articulates with a broad, thick and somewhat rectangular hypostomal sclerite; immediately below the great hook is a small dentate sclerite; the hypostomal sclerite articulates with two large bifurcated cephalopharyngeal sclerites, and in front of the upper arms of these plates is a small perforated sclerite. In a freshly prepared specimen both the retractor and extensor muscles to these sclerites can be distinctly traced. Ventral surface of the last seven segments furnished with raised bands of tactile tubercles. Posterior stigmata two in number, circular; thoracic stigmata placed sub laterally on the third segment, each consisting of apparently five circular orifices, these are connected posteriorly with a large bilateral air sac which extends along the fourth segment.

Length of adult, 11 mm.

Young larvae are much more transparent and glass like, and the large anterior mouth-hook is not developed, a blunter process taking its place.

HABITS OF THE LARVAE.—They move rapidly along a smooth surface, pulling themselves along chiefly by means of the large mouth-hook; and proceed practically in a straight line, moving the head rapidly but irregularly from side to side or up and down. There is, however, no regular alternate movement of the head during progression as in some muscid larvae. Their progress through the burrows in their food is much more rapid than on a smooth surface, and when disturbed they disappear with extraordinary rapidity. The larval stage lasted, under favourable conditions, from 14 to 21 days; *but the absence of excessive moisture* and the admission of a little light materially retarded their development, which then extended over a period of from

31 to 78 days.[1] The larvae exposed to such conditions produced much smaller pupae and correspondingly small imagines.

METHOD OF PUPATION.—This is completed in about two hours. At first the larva rapidly shortens itself, chiefly by contracting the anterior segments, and becomes barrel-shaped. At this period it is of a creamy-white colour, and the mouth parts of the larva are still visible through the soft integument. The colour rapidly changes to bright ochreous, and in the space of two hours or even less, the integument hardens and the puparium assumes its normal colour. In cases where soil was placed below the faeces the larvae generally burrowed into the former to a depth of about half an inch, but a few also pupated in the dryer portions of the dung. Where no soil was provided the larvae generally pupated at the bottom of the breeding cage.

THE PUPARIUM OR PUPA.—Colour bright terra-cotta red, changing to dark chestnut-brown a few days before the emergence of the fly. Form barrel-shaped, slightly narrowed in front, broadly rounded behind. Eleven segments only are visible, the anterior one bearing the minute bilateral thoracic stigmata of the larva; posterior segment with two large disc-like stigmata; all the segments fine with transverse striæ, the striæ, under the microscope, producing a slight irridescence; dorsally the articulations have a double series of minute papillae, one series being more minute than the other; the posterior segment has also a median longitudinal series which terminates between the stigmata; ventrally the papillae are replaced by a regular series of fine ridges, forming a distinct and relatively broad band; the last segment also bears a somewhat lunular or angular-shaped patch of more or less rounded papillae. This stage lasted from 9 to 13 days.

Length, 5 to 5.50 mm.

The larvae fed on comparatively dry faeces produced much smaller pupae—3.50-4 mm.

DEVELOPMENT OF THE NYMPH.—A few days before the emergence of the insect the cuticle of the puparium darkens and eventually splits anteriorly along the lateral and median lines and also transversely along the fourth segment; the section falls away, and the fly escapes. Prior to this the nymph undergoes its final ecdysis, pushing its effete skin off backwards into the posterior end of the puparium. On its emergence it appears as a small dark-grey fly, with thick rudimentary wings of a dull leaden colour and a deep notch in the mid costa, below which are strong convoluted folds. The head

[1] A few specimens still remain in the breeding cage, and may possibly pass the winter in this stage.

is much larger and wider than the thorax, and the abdomen is attenuated. Its subsequent development may be conveniently divided into the following stages:—

1. An extremely active period, which lasts for approximately half an hour. During this period the insect devotes nearly the whole of its attention to the escape from its environment. If placed in a glass tube with a barrier of loose cotton wool in it, the fly immediately endeavours to effect a passage through it, and this it accomplishes with marvellous rapidity, making headway by constantly inflating the frontal sac, at the same time pushing itself forward with the legs. When liberated, a great deal of time is devoted to combing out the hairs on the arista of the antennae, this being accomplished in the following way: the head is turned either to the right or left, as desired, and the frontal sac is then inflated on that side farthest from the thorax; this process lifts the antennae into a prominent position, and the long hairs of the arista are then rapidly and carefully combed out with the under surface of the anterior tibiae. The frontal sac also receives a share of attention, and so also does the abdomen, and occasionally the rudimentary wings. This stage is remarkable, in that nature so provides that, under normal conditions, the insect may successfully escape from its larval habitat before the wings develop, and so impede its progress or render its escape impossible.
2. In this stage the frontal sac is usually contracted, and the head presents a more normal condition; the fly also becomes quiescent, and remains as a rule in a fixed attitude, with the legs well displayed, and the head extended forwards, so that the narrow neck is stretched to its fullest extent. Air is then pumped into the body by repeated and alternate contractions and extensions of the abdomen. The body increases in size, and the integument becomes *extremely pallid in colour*. At this stage the wings are apparently filled with air, which passes rapidly along the costal region, then across to the hind margin, and finally the tip unfolds, sometimes aided by the use of the hind legs. The first portion of this stage sometimes occupies over twenty minutes; but the wings develop as a rule in about three minutes.
3. Fly still remains more or less quiescent, but gives some attention to cleaning itself, and when the integument and the wings are sufficiently hardened the proboscis is raised from the ventral to its normal horizontal position, when this is accomplished the insect takes flight.

Defaecation takes place shortly after the imago is perfected; the faeces being milk-like both in substance and colour.

Summary of Life Cycle.

Larvae fed on moist sheeps' dung.
Eggs procured from captive females.

Average day temperature	72° F.
Average night temperature	65° F.
Month	August.
Ova—Incubation period	2–3 days.
Larval stage	14–21 „
Pupal stage	9–13 „
Complete cycle	25–37 „

Summary of Life Cycle.

Food allowed to partly dry and some light admitted.
Temperatures and month as above.

Ova—Incubation period	2–3 days.
Larval stage	31–78 „
Pupal stage approximately as above,	
Complete cycle	42–78 „

Some larvae of this brood may hybernate through the winter.

Additional Field Notes.

While this paper was going through the press I continued my search for the larvae at various places within a few miles radius of Chester, and on 21st September my efforts were at last rewarded by finding the insect in all stages of its metamorphosis. The habitat was on the outside of a cucumber bed, at Rossett, Flintshire. Here both males and females were disporting themselves on the cucumber frame and also on some matting used for covering the glass. My attention was first given to an examination of the stable manure forming the hot bed, but this was quite unproductive, as I ventured to think that it would be, owing to the rather dry nature of the outer walls. But lying alongside the cucumber bed was a heap of grass-mowings which had accumulated during the season. The uppermost layer had only recently been deposited, and this was quite hot (90° to 98° F.), below this the grass was quite rotten and sodden with moisture, but registered a temperature of 70° F. In was in this layer that I found the first lot of larvae. They were chiefly full-fed, and some of them pupated during the next

two or three days. Continuing my search further I also found numbers of larvae and pupae, in the still older and quite cold deposits, some of them were only a few inches below the surface, others were deeper down; they sometimes occurred singly, in other cases several were found together, some were mature, others only partly developed. On disturbing the newer deposits they naturally gave off the strong smelling fumes characteristic of heated grass, and this produced a result which I had neither hoped for nor anticipated. A female Stomoxys was seen to alight on the hot and freshly disturbed grass and to quickly disappear among the interstices, there she remained for a minute or so and then flew away. The grass was carefully examined, and amongst it, at a depth of nearly three inches, were found a number of her eggs. A regular succession of females then followed, and very soon three of them were engaged in laying their eggs in a small area which could have been covered with a crown piece; the first comer being not in the least disturbed by a companion running completely over her body. In all cases the abdomen was depressed, and pushed into the material as far as possible, and in two instances the wings were partly extended, in order, apparently, to secure a firmer support. One female remained in the same spot for five minutes, and then changed her position to another a few inches away. A second female was occupied for twelve minutes in laying her eggs, but she did not change her position during the time. All three females flew away immediately afterwards, and did not seem in any way weakened by the process. For how long they survive in a state of nature it is impossible to say, but some females that were caught immediately after egg-laying died on the fourth or fifth succeeding days. Some females which were caught in glass tubes as they alighted on the grass laid their eggs immediately afterwards, and these also survived until the fourth and fifth days.

Reference has already been made to the almost noiseless flight of these flies when disporting themselves over and about their favourite haunts during the heat of the day. But I found that when the females were negotiating the habitat previous to laying their eggs the noise was distinctly audible, and resembled the characteristic hum produced by other muscids.

The day on which the foregoing observations were made was a delightfully bright and sunny one, and the hour from 3 to 3.45 in the afternoon; later, when the sun had lost its power, the flies disappeared, in their usual way, to find some sheltered spot in which to pass the night.

The eggs which were procured on this occasion were kept at a temperature varying between 64° and 67° F.: under these conditions the larvae did not begin to hatch until the *eighth day*, thus the incuba-

tion period was greatly prolonged; had they been left in the warm grass, where the temperature near the surface was 70° F., they would in all probability have hatched, as they did in the summer months, on the second or third day.

Whether the larvae of these autumn broods will pupate before the winter is at present impossible to say, but judging from the high temperature of the habitat, which will certainly be maintained for a fortnight at least, it is reasonable to assume that they will do so, and we shall probably find that the winter is passed chiefly in the pupal stage. Any material disturbance of the habitat in question would result in complete loss of the artificial heat and a sudden check to the development of the larvae. In such a case the larvae would probably hybernate through the winter and pupate in the following spring or early summer. Fortunately this is not likely to obtain in this instance, as the owner has very kindly given me undisturbed possession of the whole of the material, so that it will, it is hoped, be possible to continue the observations through the winter and spring, though little of economic importance can now be added to the habits of the insect in this country.

EXPLANATION OF PLATE XII.

Illustrating Mr. Newstead's paper on "The Life-history of *Stomoxys calcitrans*, Linn."

Fig. 1.—Eggs twice natural size.

Fig. 2.—View of the curved side of the egg. × 65.

Fig. 3.—Egg in semi-profile showing the deep spatulate groove. × 65.

Fig. 4.—Empty egg as seen in profile, with the semi-detached capsule at the anterior end. × 65.

Fig. 5.—Dorsal view of larva showing the intestinal tract and course of the main tracheae. × 7.

Fig. 6.—Three terminal segments of the larva, in profile, with the internal mouth armature: *an*, antenna; *m*, muscles; *ps*, perforated sclerite; *md*, mandible or great hook; *hs*, hypostomal sclerite; *cs*, cephalo-pharyngeal sclerites; *vt*, ventral tooth. × 60.

Fig. 6A.—Chitinised mouth armature dissected out. Reference letters as in the preceding fig. × 60.

Fig. 7.—Three terminal segments of larva, dorsal; *cst*, compound thoracic stigmen; *as*, trachea forming internal air sac. Other reference letters as in fig. 6. × 60.

Fig. 8.—Puparium or pupa. × 7.

STOMOXYS C/

XYS CALCITRANS.

REVIEWS AND CURRENT LITERATURE.

I.—General Subject.

Leathes, J. B.—Problems in Animal Metabolism. Pp. viii + 205. London: John Murray, 1906. Price 7s. 6d. net.

The contents of this interesting work were given as a course of lectures in the physiological laboratory of the London University at South Kensington, during the summer of 1904, and constitute a side of physiological chemistry which is full of interest and promise. In the words of the author: "At present it is difficult to form any conception of the future progress of medicine, to which the chemical development of physiology and pathology should not contribute more than it, or perhaps any other development, has contributed in the past.

II.—Anatomy, Physiology, and Development.

Barber, C. A.—Studies in Root-Parasitism. The Haustorium of *Santalum album*. 1. Early Stages, up to Penetration. Mem. Dept. Agric. India, Botan. Ser., 1906, vol. i, No. 1, pp. 1-30, plts. i-vii.

Berlese, Antonio.—Sopra una anomalia negli organi sessuali esterni femminei di *Locusta* viridissima, L. Redia, 1906, vol. iii, pp. 305-314; 7 figs.

Bonnet, A.—Sur l'anatomie et l'histologie des Ixodes. Compt. Rendus, 1906, pp. 296-298.

Silvestri, F.—Sviluppo dell' *Ageniaspis fuscicollis* (Dalm.) Thoms. (*Chalcididae*). Rend. d. R. Acc. d. Lincei, 1906, vol. xv.

Silvestri, F.—Contribuzioni alla conoscenza biologica degli Imenotteri Parassiti. 1. Biologia del *Litomastix truncatellus* (Dalm.). Ann. d. R. Scuola Sup. d'Agric. Portici, 1906, vol. vi, pp. 3-51, Tav. i-v, and 13 figs.

Professor Silvestri gives a valuable account of the early developmental stages of the parasitic Hymenopteron *Litomastix truncatellus*, which deposits its eggs in those of *Plusia gamma*. The account is beautifully illustrated by fifty-six figures.

Stephens, J. W. W., and Newstead, R. The Anatomy of the Proboscis of Biting Flies. Mem. xviii, Liverpool School Trop. Med., 1906, pp. 53-74, 6 plts.

A valuable piece of work, but poorly illustrated.

Stevens, N. M.—Studies on the Germ Cells of Aphids. Pp. 28, plts. i-iv. Washington: Carnegie Institution, 1906.

III.—Systematic and Geographical Distribution.

Ashmead, W. H.—Descriptions of new Hymenoptera from Japan. Proc. U.S. Nat. Mus., 1906, vol. xxx, pp. 169-201, plts. xii-xv.

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An invaluable piece of work beautifully illustrated.

Britton, W. E.—The More Important *Coccidae* or Scale Insects of Connecticut. Rpt. Con. Agric. Exp. Stat. for 1905, 1906, pp. 234-245, plts. ii-vii.

Bruner, Lawrence.—Synoptic List of Paraguayan *Acrididae*, with descriptions of new forms. Proc. U.S. Nat. Mus., 1906, vol. xxx, pp. 613-694, plts. xxxvi-xxxviii.

Busck, A.—A Review of the American Moths of the germs *Cosmopteryx*, Hübner. Proc. U.S. Nat. Mus., 1906, vol. xxx, pp. 707-713.

Caudell, A. N.—*The Locustidae* and *Gryllidae* (Katydids and Crickets) collected by W. T. Foster in Paraguay. Proc. U.S. Nat. Mus., 1906, vol. xxx, pp. 235-244.

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Cockerell, T. D. A. The Coccid germs *Eulecanium*. Canad. Entomol., 1906, pp. 83-88.

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Cockerell, T. D. A.—A New Sawfly. [*Pteronus arapahonum*]. Entomol. News, 1906, p. 220.

Cockerell, T. D. A. Notes on *Coccidae*. Proc. Ent. Soc. Wash., 1906, vol. viii, pp. 33-35.

Cockerell, T. D. A.—The South American *Coccidae* of the germs *Eriococcus*. Ibid., p. 36.

Coquillett, D. W.—A Classification of the Mosquitoes of North and Middle America. U.S. Dept. Agric., Bur. of Entom., Tech. ser. No. ii, 1906, pp. 1-31, 1 fig.

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Newstead, R., and Todd, J. L.—On a new Dermanyssid Acarid found living in the Lungs of Monkeys (*Cercopithecus schmidti*) from the Upper Congo. Mem. xviii, Liverpool School Trop. Med., 1906, pp. 41-44, 1 plt.

Newstead, R.—On another new Dermanyssid Acarid parasitic in the Lungs of the Rhesus Monkey (*Macacus rhesus*). Ibid., pp. 47-50, 1 plt.

Rehn, J. A. G.—Notes on South American Grasshoppers of the subfamily *Acridinae* (*Acrididae*), with descriptions of new genera and species. Proc. U.S. Nat. Mus., 1906, vol. xxx, pp. 371-391.
Ten new species described, but not figured.

Rehn, J. A. G. Descriptions of three new species of Katydids and a new genus of Crickets from Costa Rica. Ibid., pp. 507-1005, 8 figs.

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Wingate, W. J.—A Preliminary List of Durham Diptera, with Analytical Tables. Trans. N.H. Soc. of Northumberland, Durham, and Newcastle-upon-Tyne, 1906 (n.s.), vol. ii, pp. vii + 410 [and 8 unnumbered], plts. i-vii. London: Williams and Norgate. Newcastle-upon-Tyne: F. and W. Dodsworth. Price 9s.

Though modestly termed a Preliminary List of Durham Diptera this work is something more, and, in the poverty-stricken condition of English literature on this important Order, is sure of a welcome from all British students. As the author very aptly remarks "no order of insects has so many interesting and varied life histories, and none so deeply affects the human race, whether as protectors when acting the part of scavengers, or depredators destroying the crops, or scourges carrying the deadly micro-parasite."

After a short introduction and some information on collecting and preserving, description of chart, a table of vein and cell names, and an index to terms, the author commences with an analytical table of families, followed by one of genera and species, with lists of local species, concluding with a systematic index to local species, and various indices to families, genera, etc. Mr. Wingate supplies the characters for the determination of 2,210 species, chiefly drawn from Schiner's great work, which in itself makes the work a valuable guide.

In such an excellent compendium it is much to be regretted that the *Pulicidae*, *Cecidomyidae*, and *Psychodidae*, are omitted.

Mr. Wingate's work cannot fail to prove of great service, and should induce many who have hitherto been content with collecting, to more closely and patiently observe the habits and trace out the life-histories of the different members of this interesting Order of insects.

W. E. C.

IV.—Agricultural and Horticultural.

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Bergtheil, C.—The Study of Fermentation as applied to Agriculture. Pt. II. Agric. Journ. of India, 1906, vol. i, pp. 230-236.

Britton, W. E.—The Gypsy Moth in Connecticut. Rpt. Conn. Agric. Exp. Stat. for 1905, 1906, pp. 246-252, pl. x, and 5 text figs.

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Britton, W. E., and Viereck, H. L.—Insects Collected from the Flowers of Fruit Trees and Plants. Ibid., pp. 207-224.

Butler, E. J., and Hayman, J. M.—Indian Wheat Rusts. Mem. Dept. Agric. India, Botan. Ser., 1906, vol. i, No. 2, pp. 1-52, plts. i-v.

An exceedingly valuable paper. Three distinct rusts, *Puccinia graminis*, *P. glumarum*, and *P. triticina* commonly attack wheat, and the first two species barley, in India. As yet no entirely satisfactory explanation has been given of the way in which the disease originates each year. There are strong reasons for believing that it cannot arise from spores from the previous crop, nor to any great extent from other grasses affected with the same rusts. No "intermediate" host, bearing the accidial stage, has been found, nor is likely to be found, which can commonly produce the disease in the greater part of the infected area. A hereditary origin is possible through the use of infected seed, but is not proved so far as India is concerned.

Each variety of rust usually attacks several plants; there is, however, a tendency to develop races for each host plant which do not easily attack the other host plants. It is now possible, with the information gained, to endeavour to produce resistant varieties of wheat on a rational plan, and a search for such varieties is greatly desired.

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Martin-Duncan, F.—Insect Pests of the Farm and Garden. Pp. viii + 143, 44 figs. London: Swan Sonnenschein and Co., Ltd., 1906.

We cannot think of any reason why the author should have taken upon himself the very unnecessary task of this compilation. The information is meagre, and often misleading, and abounds in minor errors.

Maxwell-Lefroy, H.—A Report of the Investigations on the Bombay Locust (*Acridium succinctum*, Linn.). Mem. Dept. Agric. India, Entom. Ser., 1906, vol. i, No. 1, pp. 1-112, plts. i-xiii.

Maxwell-Lefroy, H.—Hairy Caterpillar Pests of Crops. Agric. Journ. of India, 1906, vol. i, pp. 187-191, plt. xv.

Moreland, W. H.—The Relation of the Weather to Rust on Cereals. Mem. Dept. Agric. India, Botan. Ser., 1906, vol. i, No. 2, pp. 53-58, and Chart.

Newell, Wilmon.—The Boll Weevil. Information Concerning its Life History and Habits. Circ. No. 9, State Crop Pest Comms. Louisiana, 1906, pp. 1-29, figs. 1-15.

Parkin, J.—Fungi parasitic upon Scale Insects (*Coccidae* and *Aleurodidae*): a general account with special reference to Ceylon Forms. Ann. R. Bot. Gard., Peradeniya, 1906, vol. iii, pp. 11-82, plts. i-iv.

The author gives an interesting account of those fungi parasitic upon scale-insects, especially those of Ceylon. He points out that while they are especially common in the tropics, and that the parasitism is the direct cause of the insect's death, though the parasitism is perhaps not of a very specialised kind. So far fungi have been found on ten distinct genera, and thirty species. Inoculating experiments did not meet with the success expected. The conditions favouring infection are evidently somewhat peculiar, and require thorough investigation.

Salmon, E. S.—Report on Economic Mycology. Journ. S.-E. Agric., Coll., Wye, No. 15, 1906, pp. 215-235, figs. 35-42.

An excellent report worthy of better figures. Treats of Apple Scab (*Fusicladium dendriticum*), Pear Scab (*F. pyrinum*), Cherry Leaf Scorch (*Gnomonia erythrostoma*), and a fungus disease of Lucerne due to the attacks of *Urophlyctis alfalfae*.

Sanderson, E. D.—The Gypsy Moth in New Hampshire. N.H. Coll. Agric. Exp. Stat., 1905, Bull. 121, pp. 83-104, 11 figs.

Sanderson, E. D.—The Brown-tail Moth in New Hampshire. Ibid., 1906, Bull. 122, pp. 107-132, 20 figs.

Sanderson, E. Dwight.—Report on Miscellaneous Cotton Insects in Texas. U.S. Dept. of Agric., Bur. of Entom., Bull. No. 57, 1906, pp. 63, plt. i, and 33 figs.

Scott, W. M.—The Control of Apple Bitter-Rot. U.S. Dept. Agric., Bur. of Plant Indus., Bull. No. 93, 1906, pp. 1-36, plts. i-viii, and 1 text fig.

Slingerland, M. V.—The Bronze Birch Borer, *Agrilus anxius*, Gory. Cornell Univ. Agric. Exp. Stat., 1906, Bull. 234, pp. 65-78, figs. 30-38.

Slingerland, M. V.—Formaldehyde as an Insecticide. Entom. News, 1906, pp. 130-133.

Swingle, Walter T.—The Prevention of Stinking Smut of Wheat and Loose Smut of Oats. U.S. Dept. Agric., Farmers' Bull. No. 250, 1906, pp. 1-16, figs. 1-7.

Theobald, Fred. V.—Report on Economic Zoology for the Year ending April 1st, 1906. Journ. S.-E. Agric. Coll., Wye, No. 15, 1906, pp. 29-138.

Professor Theobald's report suffers from being overburdened with numerous short notes really of very little value. To satisfactorily treat of upwards of one hundred animals in something less than one hundred pages is scarcely possible. We should also liked to have seen more references to the original sources of information.

W. S. C.

Thom, C.—Fungi in Cheese Ripening: Camembert and Roquefort. U.S. Dept. Agric., Bur. of An. Indus., Bull. No. 82, 1906, pp. 1-39, figs. 1-3.

Waite, M. B.—Pear-blight work and its Control in California. Off. Rpt. 31st Fruit-Growers' Conv. California, 1906, pp. 137-155.

Webster, F. M.—Some Insects affecting the production of Red Clover Seed. U.S. Dept. Agric., Circ. No. 69, 1906, pp. 1-9, figs. 1-8.

The Clover-leaf Weevil (*Phytonomus punctatus*), the Clover-flower Midge (*Dasyneura* [*Cecidomyia*] *leguminicola*), and the Clover-seed Chalcis (*Bruchophagus funebris*) are the three insects dealt with.

Webster, F. M.—The Hessian Fly. Ibid., Circ. No. 70, 1906, pp. 1-16, figs. 1-16.

Woodbridge, S. M.—Diseases of Scale Insects. Off. Rpt. 31st Fruit-Growers' Conv. California, 1906, pp. 96-99.

V.—Forestry.

VI.—Fisheries.

Archer, W. E.—Annual Report of Proceedings under the Salmon and Freshwater Fisheries Act, etc., etc., for the year 1905. Pp. xxiv + 1-89. London: Wyman and Sons, Ltd., 1906.

Leger, L.—Sur une nouvelle maladie myxosporidienne de la Truite indigène. Compt. Rend., 1906, cxlii, pp. 655, 656. Due to a species of *Chloromyxum*.

VII.—Medical.

Breinl, A.—On the Specific nature of the Spirochaeta of the African Tick Fever. The Lancet, 1906, June 16, p. 1690, and Mem. xx, Liverpool, School Trop. Med., 1906, pp. 66-72.

Breinl, A., and Kinghorn, A. Observations on the Animal Reactions of the Spirochaeta of the African Tick Fever. The Lancet, 1906, March 10, p. 668, and Mem. xx, Liverpool School Trop. Med., 1906, pp. 61-65.

Woodworth, C. W.—Mosquito control. Off. Rpt. 31st Fruit-Growers' Conv. California, 1906, pp. 107-112.

VIII.—Veterinary.

Louping-ill and Braxy Committee.—Report of the Departmental Committee appointed by the Board of Agriculture to inquire into the Aetiology, Pathology, and Morbid Anatomy and other matters connected with the Diseases of Sheep, known as Louping-ill and Braxy. Pts. I., II., and III. Pp. 36 + 342 + 13, plts. i-viii, and 29 figs. London: Wyman and Sons, Ltd., 1906. Price 3½d., 4s., and 2d.

The Committee appointed in December, 1901, consisted of Professor D. J. Hamilton, Dr. McCall, and Mr. E. G. Wheler, with Mr. R. B. Greig as Secretary, and subsequently Messrs. J. M. Young and A. H. Berry to assist.

The Report is a mine of invaluable information, and once again emphasises what can be done when the work is placed in the right hands. A foreigner would naturally suppose that, with our numerous State-aided agricultural colleges, sheep diseases had received careful and thorough attention, and that we had little to learn respecting such. Were these institutions agricultural colleges in a proper sense, they would long have possessed fully-equipped bacteriological laboratories manned by competent staffs, and such a report as that before us would probably have never been written. As it is our so-called agricultural colleges are, with a few notable exceptions, badly equipped and staffed boys' schools, ill-deserving of State or County Council support, and quite incapable of carrying out such work as this.

All interested in the diseases of sheep have long contended that there are many due to bacteria which are little understood; we are, therefore, pleased to note that this excellent Committee preface their account by stating "that the side issues which have cropped up show how little the diseases to which the sheep is liable are understood—how much, in fact, they are misunderstood—and what necessity there is for a more extended and reliable knowledge of their nature and causes. From a pathological point of view they are a perfect mine of wealth, are fraught with scientific problems of the highest interest and importance, and are most suggestive of what may turn out to be a new light on the pathology of many of the contagious and infectious diseases of man and the lower animals."

Space does not permit of our entering into the details of this valuable and voluminous report; we would, however, point out that Part I. is the "General Report," Part II., "Details of Investigation," and Part III., "Summary of Suggestions."

It is a splendid piece of work, ably carried out, and reflects the greatest credit upon all concerned in its production.

W. E. C.

Cave, T. W.—Veterinary Notes. Diseases of Sheep. Journ. S.-E. Agric. Coll., Wye, No. 15, 1906, pp. 241-250, 4 figs.

Treats of "Red Lice in Sheep," "Acari in the Feet of Lambs," "Parasitic Gastritis," and "Parasitic Pneumonia."

Dorset, M., Bolton, B. M., and McBryde, C. N.—The Etiology of Hog Cholera. U.S. Dept. of Agric., 21st Ann. Rpt. Bur. of An. Indus, 1903 [1906], pp. 138-158, plts. 5-7.

Fantham, H. B.—*Piroplasma muris*, Fant., from the Blood of the White Rat, with Remarks on the Genus *Piroplasma*. Quart. J. Micro. Sci., 1906, pp. 493-516, plt. 28.

Goodpasture, C. O.—Report of the Work against Scabies of Sheep and Cattle in 1904. Ibid., pp. 447-460.

Mohler, J. R., and Washburn, H. J.—Foot-rot of Sheep. U.S. Dept. of Agric., 21st Ann. Rpt. Bur. of An. Indus., 1905 [1906], pp. 117-137, plts. 3, 4, 1 fig.

Ransom, B. H.—The Tapeworms of American Chickens and Turkeys. U.S. Dept. of Agric., 21st Ann. Rpt. Bur. of An. Indus., 1905 [1906], pp. 268-285, figs. 1-32.

IX.—Commercial.

Duerden, J. E.—Bars in Ostrich Feathers. Agric. Journ., 1906 (May), pp. 1-16, 1 plt.

Professor Duerden has given in this preliminary article a very valuable and suggestive account of the barring in ostrich feathers, which is causing an annual loss to Cape Colony of at least £250,000.

He shows that very little is known relative to this malformation and its cause, and describes in some detail its actual nature. He suggests that the cause is an imperfect supply of nutritive material during the various stages of development, that is, while the feather is forming; as a result fewer feather cells are produced, and the parts do not separate normally. A lowering of condition may be due to imperfect feeding, internal or external parasites, or something of a more constitutional nature. Barring of this kind has been found to be prevalent in birds which are known to have been starved, and has been produced experimentally by alternate starving and feeding.

Incidentally he discusses malformations in other epidermal structures—the enamel of teeth, hair and wool, and horns, and shows that they are fundamentally of the same nature.

It is suggested that the birds should be well nourished, and kept as free from parasites as possible. Careful selection should also be given to selection in breeding. Barring may be becoming constitutional and hereditary in certain birds; at any rate, it is certain that some will be more resistant than others.

Roberts, John.—Imports and Exports of Animals and Animal Products. U.S. Dept. of Agric., 21st Ann. Rpt. Bur. of An. Indus., 1905 [1906], pp. 469-512.

Thomas, J. L.—Hybridization Experiments with the Ceylon Jungle Fowl. Spolia Zeylanica, 1906, vol. iv, pp. 19-28.

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